Report on Progress Towards Meeting the Canada-wide Standards for Particulate Matter and Ozone in Alberta

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1.0 INTRODUCTION

The *CASA (Clean Air Strategic Alliance) Particulate Matter and Ozone Management Framework*[1] is Alberta's jurisdictional implementation plan to achieve the Canada-wide Standards (CWS) for particulate matter ($PM_{2.5}$) and ozone by the 2010 target date. The framework is based on a consensus agreement reached by stakeholders representing the government, industry, municipal and public sectors. Under the framework, Alberta Environment has committed to conduct an annual assessment of ambient $PM_{2.5}$ and ozone data for all air monitoring stations in Alberta that meet the CWS data availability criteria. Under the CWS process, Alberta is only required to report for the Edmonton and Calgary Census Metropolitan Areas (CMAs).

The Edmonton CMA is the sixth largest CMA in Canada by population (1.016 million) and largest in Canada by area (9,418 km^2). The CMA has over 25 municipalities including the City of Edmonton, St. Albert, Sherwood Park, Spruce Grove, Leduc, Fort Saskatchewan, Stony Plain, Beaumont, Morinville, Devon, Redwater, Legal, Gibbons, Calmar, Bruderheim, Lamont and Bon Accord. Major industrial areas located in the CMA include the power plants in the west and southwest portion of the CMA, the industrial area of east Edmonton and the western portion of Strathcona County, the Alberta Industrial Heartland located northeast of Fort Saskatchewan, and service industries in the Nisku area.

The Calgary CMA is the fifth largest in Canada with a population of 1.060 million based on the 2005 Statistics Canada census. The area of the Calgary CMA (5,083 km^2) is just over half that of the Edmonton CMA. The Calgary CMA contains about 15 municipalities including the City of Calgary, Airdrie, Cochrane, Chestermere, and the Municipal District of Rocky View. The CMA has some oil and gas activity but not nearly as much industrial activity as the Edmonton CMA. Calgary is a major transportation hub for western Canada.

In addition to man-made sources of $PM_{2.5}$ and ozone precursors, natural, background and transboundary particulate matter and ozone influence both the Calgary and Edmonton CMAs. Biogenic sources (trees and vegetation) of volatile organic compounds (VOCs) upwind of both CMAs contribute a substantial portion of the ambient ozone measured at monitoring stations in the CMAs, especially during the spring and summer. Mixing of ozone from the upper troposphere to ground level is also a significant natural source of ozone. Smoke transported from forest fires within Alberta or from other jurisdictions can cause high $PM_{2.5}$ in both CMAs during the months of May to September. The Edmonton and Calgary CMAs are indicated in Figure A1 in the Appendix.

2.0 AIR QUALITY OVERVIEW

2.1 Ambient Air Quality

$PM_{2.5}$ and ozone data from close to 25 air monitoring stations were available from the CASA Data Warehouse during the period from 2001 to 2005. Tables 1 and 2 show ambient $PM_{2.5}$ and ozone levels at air monitoring stations in the Edmonton and Calgary CMAs, as well as several rural stations, for the 2001-03, 2002-04 and 2003-05 time periods. Data are shown before and after demonstrating the influence of natural, background or transboundary $PM_{2.5}$ and ozone for the 2001-03 time period only. Data in these tables are termed as 'pre-assessment' before removing episodes demonstrated as natural, background or transboundary influenced. Data are

termed as 'post-assessment' after these episodes have been removed. Note that the post-assessment analysis for 2002-04 and 2003-05 is not complete. Data analysis is conducted in accordance with the protocols defined by the *CASA PM and Ozone Management Framework*.

The process for conducting the data analysis includes: (1) calculating the CWS metric based on quality controlled data available through the CASA Data Warehouse (www.casadata.org); (2) identifying areas that exceeded the CWS metric and the other CASA action levels; (3) demonstrating natural, background, or transboundary influences; (4) removing episodes primarily caused by natural, background or transboundary influences; and (5) assigning final action levels to individual monitoring stations and CMAs. A simplified procedure was developed to assess natural, background, or transboundary influences for episodes that were lower than the CWS exceedance trigger but higher than the planning or surveillance triggers. Natural, background and transboundary influences are described as follows by the CASA Framework:

- *Natural sources refer to naturally occurring local or regional PM and/or ozone.*
- *Background sources refer to PM or ozone resulting from anthropogenic (man-made) or natural emissions outside of North America and natural sources within North America.*
- *Transboundary sources refer to transboundary flow of PM and/or ozone or their precursors from the U.S. or from another province or territory.*

CWS metrics were not exceeded for $PM_{2.5}$ for the Edmonton or Calgary CMAs for all three time periods (2001-03, 2002-04, 2003-05). However, the CWS metric was exceeded at the Calgary East and Northwest monitoring stations for the 2001-03 and 2002-04 time periods. Note that continuous monitoring for $PM_{2.5}$ began in November of 2002 at both of these stations and therefore a complete data set for 2001-03 and 2002-04 is not available for these stations. The major cause of CWS exceedances at the Calgary stations was smoke from forest fires that occurred in southern British Columbia and southwestern Alberta during July, August and September 2003. Forest fire smoke is considered to be natural (if within Alberta) or transboundary (outside of Alberta). During the post-assessment process, these days were removed from the analysis, resulting in final assessment values lower than the CWS for 2001-03. The post-assessment for 2001-03 shows that the Edmonton and Calgary CMAs were assigned to the surveillance action level based on the CASA Framework. Again, the post-assessment analysis for the 2002-04 and 2003-05 time periods has not been complete.

Based on the pre-assessment analysis of ozone data, the Edmonton CMA exceeded the CWS trigger of 65 ppb in both the 2001-03 and 2002-04 time periods. The CWS trigger was not exceeded in the Calgary CMA for any of the three time periods assessed. During the post-assessment analysis, a number of ozone episodes could be removed from the analysis as being caused by natural, background or transboundary ozone. Therefore, the post-assessment ozone levels for both the Edmonton and Calgary CMAs were below the CWS trigger. However, levels in both CMAs were higher than the planning trigger for ozone of 58 ppb. Therefore, based on post-assessment values, both the Edmonton and Calgary CMAs were assigned to the management plan action level under the CASA Framework.

Table 1 3-year average $PM_{2.5}$ (µg/m³) concentration in the Province of Alberta*.

Community Name	Monitoring station	Pre-assessment			Post-assessment			Monitoring Period
		2001-03	2002-04	2003-05	2001-03	2002-04	2003-05	
Edmonton CMA	Edmonton Central	21	22	19	18	post-assessment not complete	post-assessment not complete	Jan 2001 to Dec 2005
	Edmonton East	24	24	21	20			Jan 2001 to Dec 2005
	Edmonton Northwest	26	23	20	23			Jan 2001 to Dec 2005
	Edmonton South	no data	no data	see note	no data			Sept 2005 to Dec 2005
	Fort Saskatchewan	27	18	16	25			Nov 2001 to Dec 2005
	Tomahawk	14	15	13	14			Jan 2001 to Dec 2005
	Genesee	no data	see note	see note	no data			May 2004 to Dec 2005
	Power	no data	see note	see note	no data			July 2004 to Dec 2005
	For CMA	**20**	**19**	**16**	**19**			
Calgary CMA	Calgary Central	24	23	22	18			Jan 2001 to Dec 2005
	Calgary East	see note	30	25	see note			Nov 2002 to Dec 2005
	Calgary Northwest	see note	23	19	see note			Nov 2002 to Dec 2005
	For CMA	**25**	**24**	**22**	**18**			
	Lethbridge	see note	see note	12	see note			Oct 2003 to Dec 2005
	Hightower Ridge	11	12	see note	11			Jan 2001 to Sept 2004
	Drayton Valley	no data	no data	see note	no data			Feb 2005 to Dec 2005
	Edson	no data	see note	see note	no data			Nov 2004 to Dec 2005
	Fort McMurray-Athabasca Valley	15	15	13	15			Jan 2001 to Dec 2005
	Fort McMurray-Patricia McInnes	13	15	15	13			Jan 2001 to Dec 2005
	Fort McKay (WBEA)	19	21	18	14			Jan 2001 to Dec 2005
	Fort Chipewyan (WBEA)	8	11	11	8			Jan 2001 to Dec 2005
	Albian Mine Site	18	18	16	12			Jul 2001 to Dec 2005
	Millennium	see note	16	18	see note			Sept 2001 to Dec 2005
	Syncrude UE1	see note	see note	13	see note			Sep 2002 to Dec 2005
	Red Deer - Riverside	19	17	15	14			Jan 2001 to Dec 2005
	Elk Island	see note	17	14	see note			Jan 2003 to Dec 2005
	Lamont	see note	see note	21	see note			Jan 2003 to Dec 2005
	Henry Pirker	no data	see note	see note	no data			Feb 2004 to Dec 2005
	Evergreen Park	no data	no data	see note	no data			Mar 2005 to Dec 2005
	Smoky Heights	no data	no data	see note	no data			Apr 2005 to Dec 2005
	Beaverlodge	no data	no data	see note	no data			Apr 2005 to Dec 2005
	Crescent Heights	no data	see note	see note	no data			Jan 2004 to Dec 2005

* The CWS for $PM_{2.5}$ is 30 µg/m³ calculated as a 24-houraverage. Achievement to be based on the 98th percentile ambient measurement annually, averaged over three consecutive years.

note - available data does not meet data availability criteria

Also note that the CMA number is not an average of the three-year averages for the individual stations. The CMA number is calculated by averaging the daily PM concentrations across all stations within the CMA, calculating the 98th percentile annual value for those daily averages, then averaging those 98th percentile numbers.

Table 2 3-year average ozone concentration (ppb) in the Province of Alberta*.

Community Name	Ozone reporting station	Pre-assessment			Post-assessment			Monitoring Period
		2001-03	2002-04	2003-05	2001-03	2002-04	2003-05	
Edmonton CMA	Edmonton Central	55	55	52	55	post-assessment not complete	post-assessment not complete	Jan 2001 to Dec 2005
	Edmonton East	66	65	59	62			Jan 2001 to Dec 2005
	Edmonton Northwest	64	64	57	61			Jan 2001 to Dec 2005
	Edmonton South	no data	no data	see note	no data			Sept 2005 to Dec 2005
	Fort Saskatchewan	63	61	55	61			Jan 2001 to Dec 2005
	Tomahawk	67	68	63	63			Jan 2001 to Dec 2005
	Genesee	no data	see note	60	no data			May 2004 to Dec 2005
	For CMA	**69**	**68**	**64**	**64**			
Calgary CMA	Calgary Central	52	51	49	52			Jan 2001 to Dec 2005
	Calgary East	53	54	52	53			Jan 2001 to Dec 2005
	Calgary Northwest	64	63	58	63			Jan 2001 to Dec 2005
	For CMA	**64**	**63**	**58**	**63**			
	Esther	see note	no data	no data	see note			Jan 2001 to Dec 2001
	Lethbridge	see note	see note	58	see note			Oct 2003 to Dec 2005
	Hightower Ridge	66	64	64	57			Jan 2001 to Sept 2004
	Violet Grove	65	64	63	59			Jan 2001 to Dec 2005
	Carrot Creek	67	64	62	58			Jan 2001 to Dec 2005
	Steeper	64	64	see note	57			Jan 2001 to Aug 2003
	Fort McMurray-Athabasca Valley	53	53	53	53			Jan 2001 to Dec 2005
	Fort McKay	54	54	55	54			Jan 2001 to Dec 2005
	Fort McMurray-Patricia McInnes	54	52	52	54			Jan 2001 to Dec 2005
	Fort Chipewyan	53	55	54	53			Jan 2001 to Dec 2005
	Syncrude UE1	see note	54	53	see note			Sept 2002 to Dec 2005
	Caroline	68	64	62	61			Jan 2001 to Dec 2005
	Red Deer - Riverside	63	62	58	60			Jan 2001 to Dec 2005
	Elk Island	see note	59	59	see note			Jan 2003 to Dec 2005
	Lamont	see note	61	60	see note			Jan 2003 to Dec 2005
	Henry Pirker	see note	see note	54	see note			Feb 2004 to Dec 2005
	Beaverlodge	55	53	55	55			Jan 2001 to Dec 2005
	Crescent Heights	see note	see note	57	see note			Jan 2004 to Dec 2005

* The CWS for ozone is 65 ppb calculated as an eight-hour average. Achievement to be based on the 4th highest measurement annually averaged over three consecutive years.

note - available data does not meet data availability criteria

Also note that the CMA number is not an average of the three-year averages for the stations within the CMA. The CMA number is arrived at by taking the highest number of any station within the CMA in each of the three years, then averaging those highest numbers. As such, the three-year average for the CMA is always at least as high as the highest single station within it, or possibly higher.

2.2 2002 Emissions Inventory and Forecasts to 2015

Environment Canada's Pollution Data Branch conducted criteria air contaminant (CAC) emissions inventories for Alberta for 1990, 1995, 2000 and 2002. Using this inventory data, they

have also developed forecast CAC emissions for 2005, 2010 and 2015. Figures 1 and 2 show the forecast Alberta emissions of CACs up to 2015 and the 2002 reported emissions by source category for nitrogen (NOx), sulphur oxides (SOx), volatile organic compounds (VOCs) and ammonia (NH_3). Figure A2 in the Appendix shows the same information for carbon monoxide (CO), total particulate matter (PM_{tot}), particulate matter less than 10 micrometres in diameter (PM_{10}) and particulate matter less than 2.5 micrometres in diameter ($PM_{2.5}$). A more detailed description of the 2002 CAC inventory and forecasted emissions is contained in the Appendix.

2.3 Air Emissions Inventory for the Calgary and Edmonton CMAs

Tables A1 and A2 in the Appendix show the proportion of emissions by source type from an emissions inventory developed by RWDI West Inc. (2001)[ii] based on the 1995 national CAC inventory. Note that Environment Canada's Pollution Data Branch has updated this inventory since the RWDI work was completed. This inventory shows that industrial emissions are the major source of VOCs in both the Edmonton (60%) and Calgary (83%) CMAs. The major sources of NOx in the Edmonton CMA are electric power generation (41%), mobile sources (32%) and industrial emissions (21%). In the Calgary CMA this inventory shows that over half of NOx emissions are from mobile sources (52%) with a large portion also from industrial emission sources (30%). Based on this inventory, the major $PM_{2.5}$ sources in the Edmonton CMA are mobile sources (34%) followed by electric power generation (29%). In the Calgary CMA, the major $PM_{2.5}$ sources were reported to be mobile sources (42%) followed by industrial emission sources (22%).

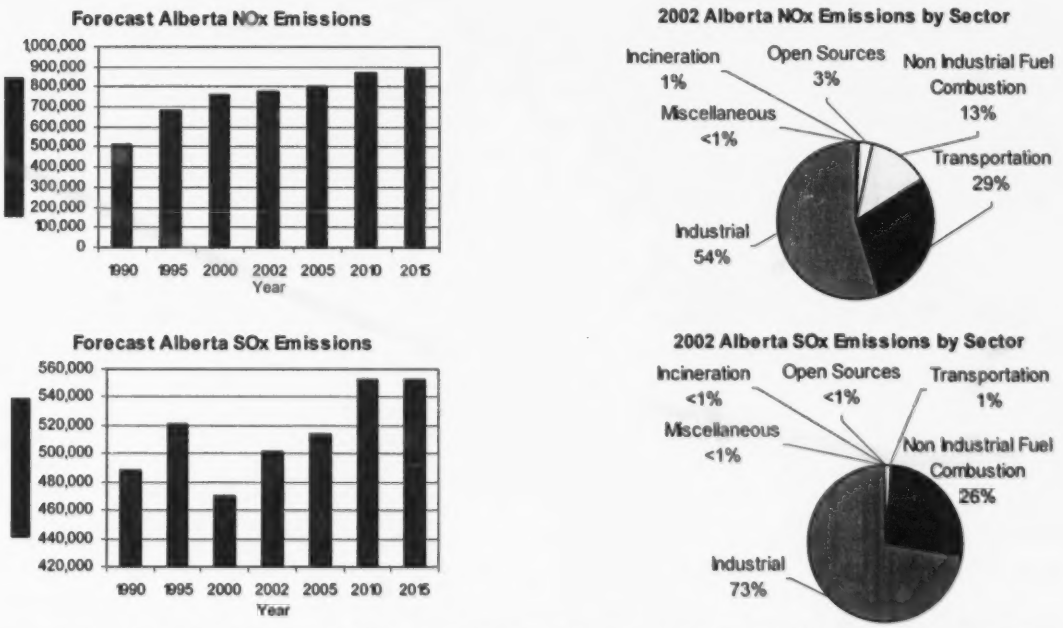
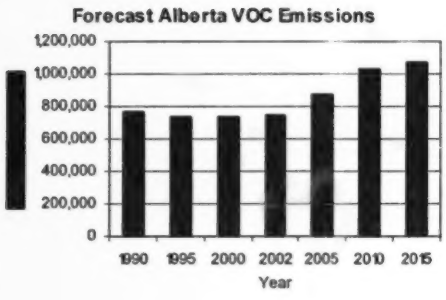
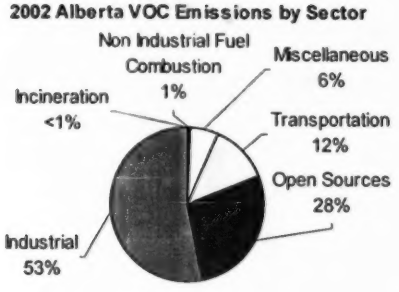
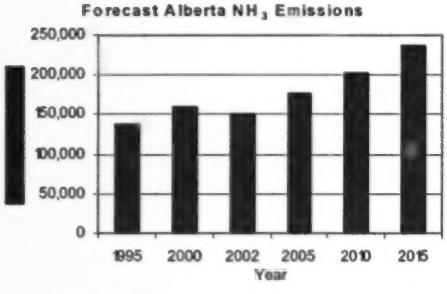


Figure 1 CAC emissions for NOx and SOx in Alberta (data provided by Environment Canada).







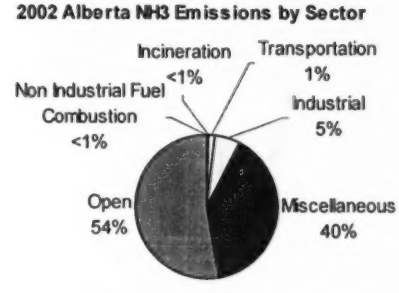


Figure 2 CAC emissions for VOCs and NH_3 in Alberta (data provided by Environment Canada).

3.0 STATUS OF ACTIVITIES RELATED TO PM AND OZONE IMPLEMENTATION

Three action triggers and four action levels have been established under the *CASA PM and Ozone Management Framework*. The metrics for the action triggers below the numeric CWS are calculated using the same process as the CWS metrics. The calculation metrics are described in the *Guidance Document for the Management of Fine Particulate Matter and Ozone in Alberta*[iii]. The action levels are described as follows and presented in Figure 3:

- **Mandatory Plan to Reduce Below CWS (above the CWS exceedance trigger)**
  Alberta Environment will develop and implement a management plan containing measures to reduce ambient concentrations to below the numeric CWS within two years, working with stakeholders where possible. The numeric CWS for $PM_{2.5}$ is 30 micrograms per cubic metre ($\mu g/m^3$) and for ozone is 65 parts per billion (ppb).
- **Management Plan (Above the planning trigger and below the CWS exceedance trigger)**
  A management plan will be developed and implemented by stakeholders with appropriate actions that consider factors such as: (1) trends in population growth and industrial activity, (2) trends in ambient air quality, and (3) ambient concentration relative to the planning trigger. The goal of the management plan level is to prevent a future exceedance of the CWS and to maintain or improve air quality. Alberta Environment may impose a plan if stakeholders do not develop a plan within two years. The planning trigger is 20 $\mu g/m^3$ for $PM_{2.5}$ and 58 ppb for ozone.

- **Surveillance Actions (above surveillance trigger and below planning trigger)** Alberta Environment with support from the airshed zones, should take steps to ensure that sources of elevated concentrations are determined and that trends in ambient concentrations are monitored and analysed. The surveillance trigger is 15 $\mu g/m^3$ for $PM_{2.5}$. For ozone, Alberta Environment will determine which areas of the province are in the surveillance and baseline monitoring action levels on an annual basis.
- **Baseline Monitoring and Data Gathering (below surveillance trigger)** Alberta Environment or airshed zones should conduct ongoing monitoring of ambient air quality. No additional data analysis is required.

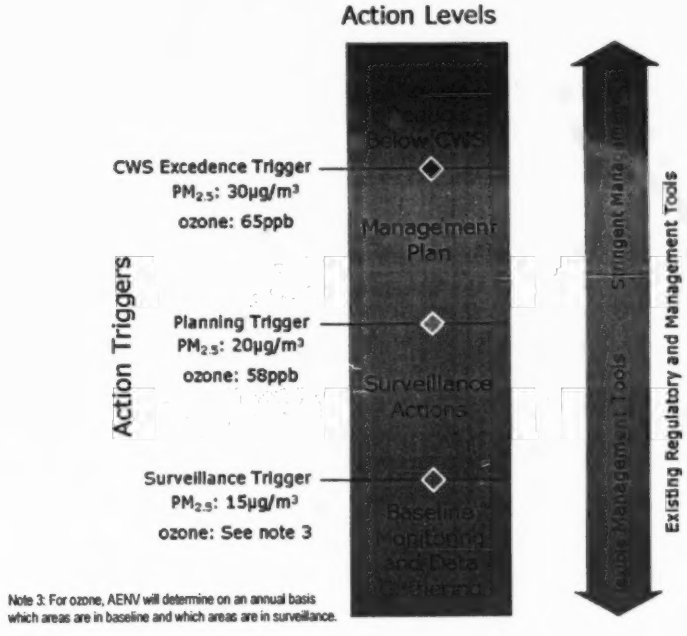


Figure 3 Alberta's particulate matter and ozone management framework. ***Extracted from the CASA Particulate Matter and Ozone Management Framework (September 2003).***

4.0 NEXT STEPS

Based on the CASA Framework, a management plan will be developed and implemented by stakeholders in areas of the province that are assigned to the Management Plan action level. The management plan will include appropriate actions that consider factors such as population growth, industrial activity and air quality trends with the goal of preventing future exceedances of the CWS trigger. Alberta Environment may impose a management plan if stakeholders do not develop a plan within two years.

The process for developing an air quality management plan is identified by the CASA Framework. Alberta Environment or the affected airshed zone leads the identification of key stakeholders, both from the emissions sources and receptor communities. The airshed or other multi-stakeholder organizations may choose to lead the development of the management plan. It

is suggested that the CASA consensus model be used during this process. If an airshed zone or other multi-stakeholder organization does not exist in the affected area, Alberta Environment will lead the development of the management plan. Some activities that may be part of the management plans include:

1. Conducting further detailed episode analysis to determine causes of elevated $PM_{2.5}$ and/or ozone levels.
2. Developing a strategy on what stakeholders can do to ensure ambient air quality levels remain below the CWS in the future. This strategy will take into account factors such as:
   - current and future emission scenarios,
   - detailed emissions inventories for affected areas, and
   - review of monitoring needs for air quality management (e.g. refinement of ozone precursor and ozone monitoring network in and adjacent to the affected area).
3. Improving air quality forecasts to determine when smog episodes are expected to occur.
4. Improving public notification of existing and forecasted smog episodes through the media.
5. Increasing education so that the public can change their habits especially on smog days (anti-idling, limit use of motorized vehicles, encourage carpooling).

In areas where the elevated levels are influenced by another region within Alberta, there will be a benefit in partnering with or lobbying the source region during the development of a management plan.

The CASA Framework identifies the range of management tools that could be used by affected areas that are developing air quality management plans. These tools are listed below:

1. Voluntary Programs and Approaches
2. Existing Programs and Policies
3. Environmental Assessment
4. Source Performance Standards
5. Pollution Prevention Planning
6. Ambient Air Quality Guidelines
7. Codes of Practice
8. Industry Stewardship Initiatives
9. Public-Private Partnerships, Agreements
10. Education, Training
11. Reward, recognition programs
12. Land use policy and planning
13. Emissions trading & other market mechanisms
14. Offsetting new sources
15. Establish reduction targets
16. More stringent emission standards/limits
17. Air Quality Index & Forecasting
18. Taxes and Fees (used as either incentives or disincentives)
19. Promote industrial ecology
20. Energy efficiency
21. Green energy policies
22. Transportation Demand Management
23. Zone Formation Analysis

These management tools may be implemented through a wide variety of regulatory and non-regulatory mechanisms. The intent of the CASA Framework is that management actions be developed and implemented through a process that will facilitate multi-stakeholder responsibility for air quality management. The management plan may range from compulsory actions such as regulations and bylaws to voluntary actions such as providing incentives for use of environmentally responsible modes of transportation. Management actions can be implemented by a variety of organizations including government (federal, provincial or municipal), the private sector and non-government environmental associations.

APPENDIX

A1 Census Metropolitan Areas

The CASA Framework requires reporting for all ambient air monitoring stations in the province that meet the data availability criteria defined by the *Guidance Document of Achievement Determination – Canada-wide Standards for Particulate Matter and Ozone*[iv]. However, only reporting for the Edmonton and Calgary Census Metropolitan Areas (CMAs) is required for national reporting. A CMA is an area with an urban core population of at least 100,000 people. The Edmonton and Calgary CMAs are indicated in Figure A1.

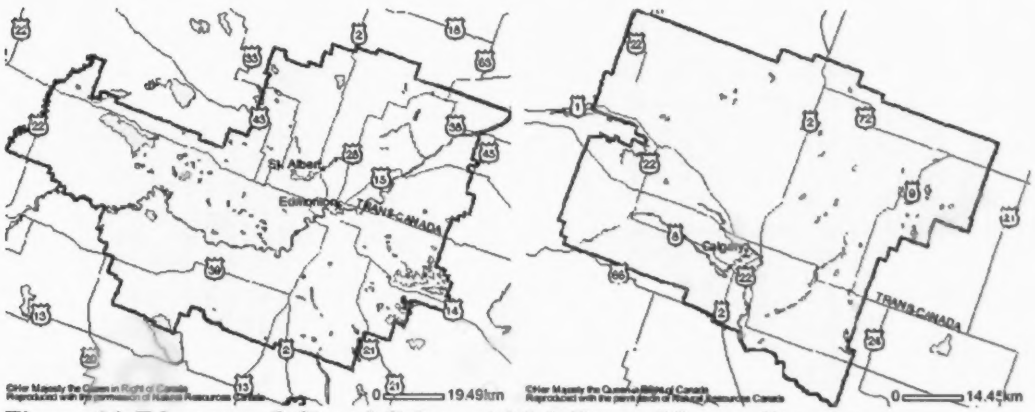


Figure A1 Edmonton (left) and Calgary (right) Census Metropolitan Areas.

A1 Emissions Inventory

The following section examines the forecasted emissions and the 2002 CAC emissions inventory by sector (including open sources). CACs include NOx, SOx, VOCs, NH_3, CO, PM_{tot}, PM_{10} and $PM_{2.5}$. Emissions inventory estimates for NOx, SOx, VOCs and NH_3 are shown in Figures 1 and 2 (pages 5 and 6) while emission estimates for CO, PM_{tot}, PM_{10} and $PM_{2.5}$ are indicated in Figure A2.

Environment Canada forecasts that overall emissions of NOx in Alberta will increase by 14% between 2002 and 2015. Industrial sources made up over half (54%) of total Alberta NOx emissions in 2002. Transportation was the second largest source contributing 29% of 2002 NOx emissions. Non-industrial fuel combustion, primarily electric power generation, was the other large source of NOx emissions with 13% of total emissions. Open sources, incineration and miscellaneous sources each contributed to less than 5% of total 2002 NOx emissions.

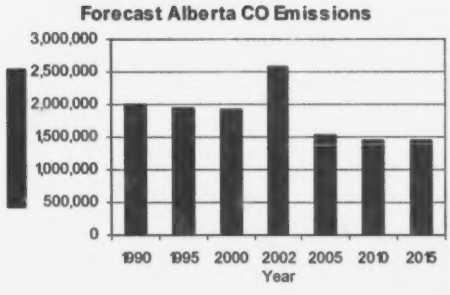
Overall emissions of SOx in Alberta are forecast to increase by 10% from 2002 to 2015 by Environment Canada. The largest sources of 2002 SOx emissions in Alberta were from industry, which was responsible for 73% of all SOx emissions in the province. Non-industrial fuel combustion, primarily electric power generation, was the second largest source and was responsible for 26% of SOx emissions. Transportation, open sources, incineration and miscellaneous sources were each responsible for 1% or less of 2002 SOx emissions.

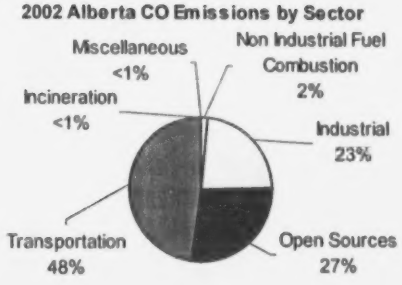
Environment Canada forecasts that overall VOC emissions in Alberta will increase by 45% between 2002 and 2015. Industrial sources were responsible for over half (53%) of total 2002 Alberta VOC emissions. Open sources, primarily agriculture, were the second largest contributors to VOC emissions, emitting about 28% of total VOC emissions. Transportation and miscellaneous sources were responsible for 12% and 6% respectively of 2002 VOC emissions. Non-industrial fuel combustion and incineration sources were responsible for 1% or less of VOC emissions in 2002.

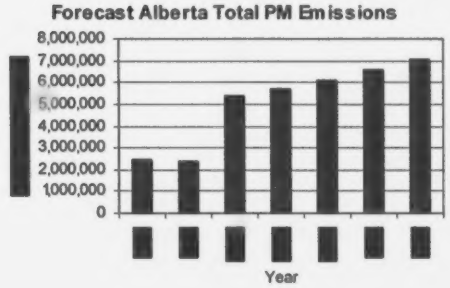
NH_3 emissions in Alberta are predicted to be 58% higher in 2015 than they were in 2002, based on Environment Canada's forecast. Open sources, primarily agriculture, accounted for over half (54%) of total 2002 Alberta NH_3 emissions. Miscellaneous sources, primarily pesticides and fertilizer application sources, were the second largest contributors and were responsible for 40% of NH_3 emissions. Industrial sources were also significant, contributing 5% of total NH_3 emissions. Transportation, incineration and non-industrial fuel combustion sources were each responsible for 1% or less of total 2002 NH_3 emissions.

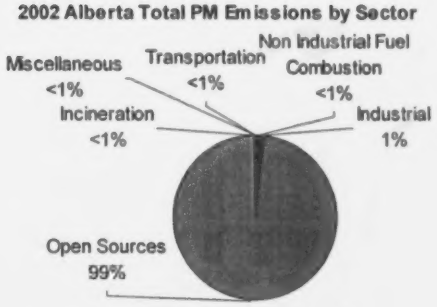
Based on the Environment Canada forecast, overall CO emissions in Alberta will decrease by 43% between 2002 and 2015. Transportation sources were responsible for nearly half (48%) of Alberta CO emissions in 2002. Open sources, primarily forest fires, were the second largest contributor (27%) to CO emissions. Industrial sources were also significant contributors, emitting 23% of 2002 CO emissions in the province. Non-industrial fuel combustion, miscellaneous and incineration sources were each responsible for 2% or less of CO emissions in 2002.

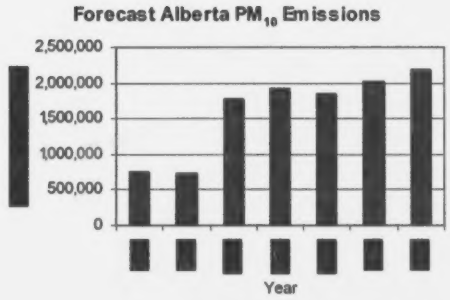
Environment Canada forecasts that particulate matter emissions in Alberta will increase by 4, 20 and 23% by 2015 for $PM_{2.5}$, PM_{10} and PM_{tot}, respectively. The vast majority of PM_{tot} (99%), PM_{10} (96%) and $PM_{2.5}$ (87%) emissions were from open sources in 2002. For $PM_{2.5}$, industrial sources were the second largest contributor of emissions with 7% of total 2002 emissions. Transportation, non-industrial fuel combustion, miscellaneous and incineration sources were each responsible for 3% or less of 2002 $PM_{2.5}$ emissions.

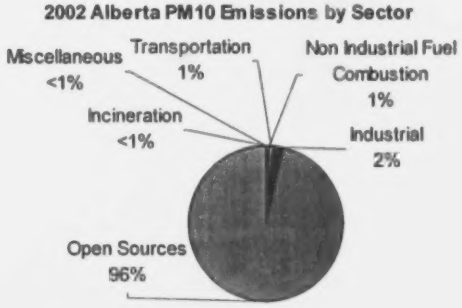


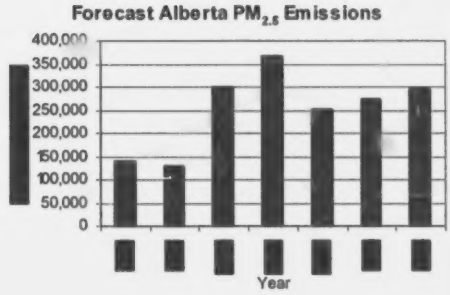












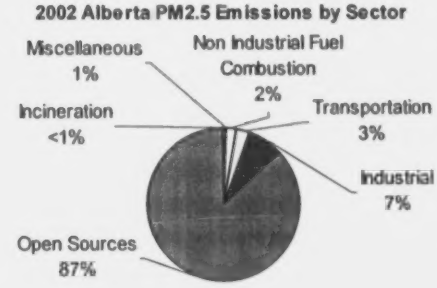


Figure A2 CAC emissions for CO, total PM, PM_{10} and $PM_{2.5}$ in Alberta (data provided by Environment Canada).

Table A1 Percentage of emissions by source category in the Edmonton CMA ***(source: RWDI West Inc., 2001).***

Edmonton Census Metropolitan Area – 1995 CAC Emissions Inventory							
Category	VOC	NOx	CO	SOx	PM_{10}	$PM_{2.5}$	NH_3
Electric Power Generation	1%	41%	2%	67%	5%	29%	0%
Commercial Fuel Use	0%	5%	1%	0%	1%	8%	3%
Residential Fuel Use	2%	2%	4%	0%	1%	7%	0%
Mobile Sources	21%	32%	91%	2%	23%	34%	2%
Industrial Emissions	60%	21%	2%	31%	46%	14%	24%
Other	16%	0%	0%	0%	23%	8%	70%
Total	100%	100%	100%	100%	100%	100%	100%

Table A2 Percentage of emissions by source category in the Calgary CMA ***(source: RWDI West Inc., 2001).***

Calgary Census Metropolitan Area – 1995 CAC Emissions Inventory							
Category	VOC	NOx	CO	SOx	PM_{10}	$PM_{2.5}$	NH_3
Electric Power Generation	0%	3%	0%	0%	0%	0%	0%
Commercial Fuel Use	0%	11%	1%	1%	1%	10%	2%
Residential Fuel Use	1%	4%	6%	0%	2%	14%	0%
Mobile Sources	7%	52%	84%	3%	19%	42%	3%
Industrial Emissions	83%	30%	3%	96%	61%	22%	0%
Other	9%	0%	6%	0%	17%	11%	94%
Total	100%	100%	100%	100%	100%	100%	100%

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[i] Clean Air Strategic Alliance. 2003. CASA Particulate Matter and Ozone Management Framework. Prepared by the Particulate Matter and Ozone Project Team for the Clean Air Strategic Alliance Board of Directors. September 2003. ISBN 1-896250-23-8.

[ii] RWDI West Inc. 2001. Alberta Emissions Inventory in Support of Particulate Matter and Ozone Modelling. Submitted to Alberta Environment on July 13, 2001. Project Number: 01-159W.

[iii] Clean Air Strategic Alliance. 2003. Guidance Document for the Management of Fine Particulate Matter and Ozone in Alberta. Prepared by the Particulate Matter and Ozone Project Team for the Clean Air Strategic Alliance Board of Directors. September 2003. ISBN 1-896250-24-6.

[iv] The Canadian Council of Ministers of the Environment. 2000. Guidance Document of Achievement Determination – Canada-wide Standards for Particulate Matter and Ozone. ISBN 1-896997-41-4. PN 1330.